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PRIORITY FACTORS IN THE DEVELOPMENT OF SUSTAINABLE OYSTER MUSHROOM AGRIBUSINESS

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Abstract: Determining factors in the development of sustainable oyster mushroom agribusiness is an important issue presently considering oyster mushrooms have good opportunities and potential. This research aims to identify prioritizing factors in the development of sustainable oyster mushroom agribusiness in Kubu Raya Regency West Kalimantan Province. This research uses the descriptive method. Respondents were 30 key informants from related agencies (Agriculture Office of Food Crops and Horticulture, agricultural extension workers, researchers in horticulture, oyster mushroom entrepreneurs, and oyster mushroom traders). The research was conducted from March to June 2018. Data were analyzed by the Analytical Hierarchy Process (AHP) analysis. The result indicates that supporting facilities aspect is the most important criterion to be considered. The main sub-criteria are oil palm empty fruit bunches (OPEFB) potential (ecology), return on investment (financial), perception and attitudes of the community in consuming oyster mushrooms (socio-culture), capital (institution), labor availability (human resources), adoption readiness (technology), and market (supporting facilities). The main sub-sub criterion is market demand.

Keywords: AHP, market demand, oil palm empty fruit bunches, supporting facilities

Abstrak: *Penentuan faktor-faktor dalam pengembangan agribisnis jamur tiram berkelanjutan merupakan isu yang penting saat ini mengingat jamur tiram memiliki peluang dan potensi yang baik untuk dikembangkan. Penelitian ini bertujuan untuk mengidentifikasi dan memprioritaskan faktor-faktor dalam pengembangan usaha agribisnis jamur tiram berkelanjutan di Kabupaten Kubu Raya Provinsi Kalimantan Barat. Metode penelitian yaitu metode deskriptif. Responden yaitu key informan berjumlah 30 orang yaitu pihak instansi terkait (Dinas Pertanian Tanaman Pangan dan Hortikultura, penyuluh pertanian, peneliti bidang hortikultura, pengusaha jamur tiram, dan pedagang pengumpul jamur tiram). Penelitian dilakukan bulan Maret sampai Juni 2018. Analisis data menggunakan Analytical Hierarchy Process (AHP). Hasil mengindikasikan bahwa aspek sarana penunjang adalah kriteria utama yang paling penting untuk dipertimbangkan. Sub-kriteria utama yaitu potensi tandan kosong kelapa sawit (ekologi), tingkat pengembalian investasi (finansial), persepsi dan sikap masyarakat dalam mengkonsumsi jamur tiram (sosial budaya), kelembagaan permodalan (kelembagaan), ketersediaan tenaga kerja (sumber daya manusia), kesiapan adopsi teknologi (teknologi), pasar (sarana penunjang). Sub-sub kriteria utama yaitu permintaan pasar.*

Kata kunci: *AHP, tandan kosong kelapa sawit, sarana penunjang, permintaan pasar*

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INTRODUCTION

Indonesia is one of the countries producing horticultural crops with the main commodities such as cabbages, shallots, potatoes, red peppers, and cayenne peppers. The high demand for horticultural products is due to the majority of Indonesian consume vegetables (97.29%) and 3 out of 4 people consume fruits (BPS, 2017). Furthermore, the data shows that the average consumption of Indonesian horticultural products is 70 grams/ person/day for vegetable consumption and 38.8 grams/person/day for fruit consumption (Hermina and Prihatini, 2016).

Mushrooms are popular horticultural products for Indonesian because they taste delicious, have beneficial nutritional content for body health, and act as an alternative herbal treatment. The nutritional values in 100 grams of oyster mushrooms are 19-35% protein, 1.7-2.2% fat, carbohydrates, vitamin B, vitamin D, vitamin C, and minerals (Sumarni, 2006). Mushroom products are one of Indonesia's export products with total exports of 273,331 kg in 2016 and FOB value of US$ 1,153,182 (BPS, 2016). Mushroom consumption in 2013-2017 increased by 3.96%, while the progress of mushroom availability only reached 3.58% (Pusdatin, 2017). Thus, it opens an opportunity for farmers to create mushroom cultivation businesses.

Oyster mushrooms are one of the potentially-developed mushroom commodities because of the easily obtained spawns, relatively easy maintenance, and reasonably high mushroom selling price. Oyster mushroom products can be consumed in the form of foodstuff or processed into mushroom chips. Oyster mushroom agribusiness has promising potential because it can provide optimal benefits for oyster mushroom cultivators and processed oyster mushroom entrepreneurs (Pramudya and Cahyadinata, 2012; Candra et al. 2014). In addition, oyster mushroom agribusiness can be organized with low costs and technology easily adopted and implemented by the business actors (Chioza and Ohga, 2014).

The implementation of oyster mushroom agribusiness in Indonesia requires strengthening the adoption of cultivation technology and post-harvest processing, institution strengthening, management optimization, and the use of production factors (Mabuza et al. 2012; Iriantinah, 2014; Li and Hu, 2014; Febrianda and Tokuda, 2017). Farmers' willingness to starting oyster mushroom agribusiness is influenced by marital status, formal education, farmer group membership, mushroom consumption level, market availability, farming experience, and land area (Ongoche et al. 2017).

One of the main factors to be considered in the oyster mushroom cultivation is the use of the right growing media to increase the productivity of the oyster mushroom business. Mushroom growing media must contain carbohydrates (source C) and protein (source N) to support the optimal growth and development of mushrooms (Sumiati and Shopa, 2009). Several types of mushroom growing media proven to provide optimal production results include sawdust, bagasse, rice straw waste, rice bran, corn flour, and agricultural lime (Sutarman, 2012; Maulidina et al. 2015; Setyaningsih et al. 2015; Rahmawati et al. 2016).

In West Kalimantan, one of the mushroom growing media that can be used for oyster mushroom cultivation is the oil palm empty fruit bunches (OPEFB). OPEFB has abundant availability due to the vast oil palm area of 1,055,656 ha of large plantations and 407,410 ha of smallholder plantations in 2016 (BPS, 2017b). The use of OPEFB as the growing media and a mixture of several additional ingredients can provide optimal growth of mushroom production (Hidayati et al. 2015; Purindraswari et al. 2016). Oyster mushroom agribusiness using OPEFB as the growing media is also feasible to be cultivated and can provide benefits for oyster mushroom entrepreneurs (Sulistiawati et al. 2017).

Some researches related to the development strategy for oyster mushroom agribusiness have been carried out by researchers (Iriantinah, 2014; Li and Hu, 2014; Dimyati and Astarina, 2016; Fatria, 2017; Febrianda and Tokuda, 2017; Ongoche et al. 2017). The purpose of this research is to determine priority factors in the development of sustainable oyster mushroom agribusiness with OPEFB as the growing media. The novelty of the research is the development of sustainable oyster mushrooms agribusiness that was conducted in this study using OPEFB as a growing media. The location of this study is in Kubu Raya Regency, West Kalimantan Province with the consideration that many CPO factories in this location. Therefore, the availability of OPEFB is abundance and then utilized by the local community as an oyster mushroom growing media.

METHODS

This research uses the descriptive method by collecting data, testing hypotheses, and finding answers for research problems (Kuncoro, 2003). The research was conducted in Kubu Raya Regency from March to June 2018. Data sources were from primary and secondary data. Primary data was obtained from the interviews results with key informants related to criteria determination and alternative factor formulation. Secondary data was obtained from relevant agencies such as Statistics Indonesia, the Agriculture Office of Food Crops and Horticulture, and other literature. Determination of the key informants was through purposive sampling based on their expertise (Sekaran and Bougie, 2010), i.e. 30 respondents from the related agencies (Agriculture Office of Food Crops and Horticulture, agricultural extension workers, researchers in horticulture, oyster mushroom entrepreneurs, and oyster mushroom traders).

Data were analyzed used AHP (Analytic Hierarchy Process). AHP analysis stages include: 1) the components explanation in building a hierarchical model. The model formulation is constructed as comprehensive as possible to meet all the possibilities in the priority factor. The hierarchy model is classified into 4 levels (Figure 1). The level is the overall goal of the model. Level 2 is the main criteria for achieving goals, level 3 is sub-sub criteria, and level 4 is sub-sub criteria for ecology, financial, socio-culture, human resources, and supporting facilities criteria. The goal of this model is the formulation of the prioritizing factors in the development of oyster mushroom agribusiness in Kubu Raya Regency West Kalimantan Province; 2) Calculation of the geometric mean. The collected data will be converted into a geometric mean for each compared pair. The geometric mean method is used to convert different values into a single value for each criterion, sub-criteria, and sub criteria; 3) Comparative judgment, which makes a judgment on the relative importance between the two criterias at a certain level in relation to the preceding level. This judgment is the core of AHP because it influences the priority of criteria. The results are then presented in the pairwise comparison matrix; 4) Determination of priorities. The eigenvector value can be determined from each pairwise comparison matrix to get the local priority. Because the pairwise comparison matrix is found at each level, global priority can be obtained by synthesizing local priorities; 5) Calculation of consistency ratio. AHP allows the judgment inconsistency by providing the consistency ratio in which CR>1 is unacceptable inconsistent and CR<1 is sufficiently consistent. Figure 1 illustrates the hierarchy process of AHP analysis; 6) Sensitivity analysis. The criteria importance depends on time (Saad, 2016). Through sensitivity analysis, decision makers can monitor the sustainability of the factors if there is a change in the level of importance which influences the weighting value.

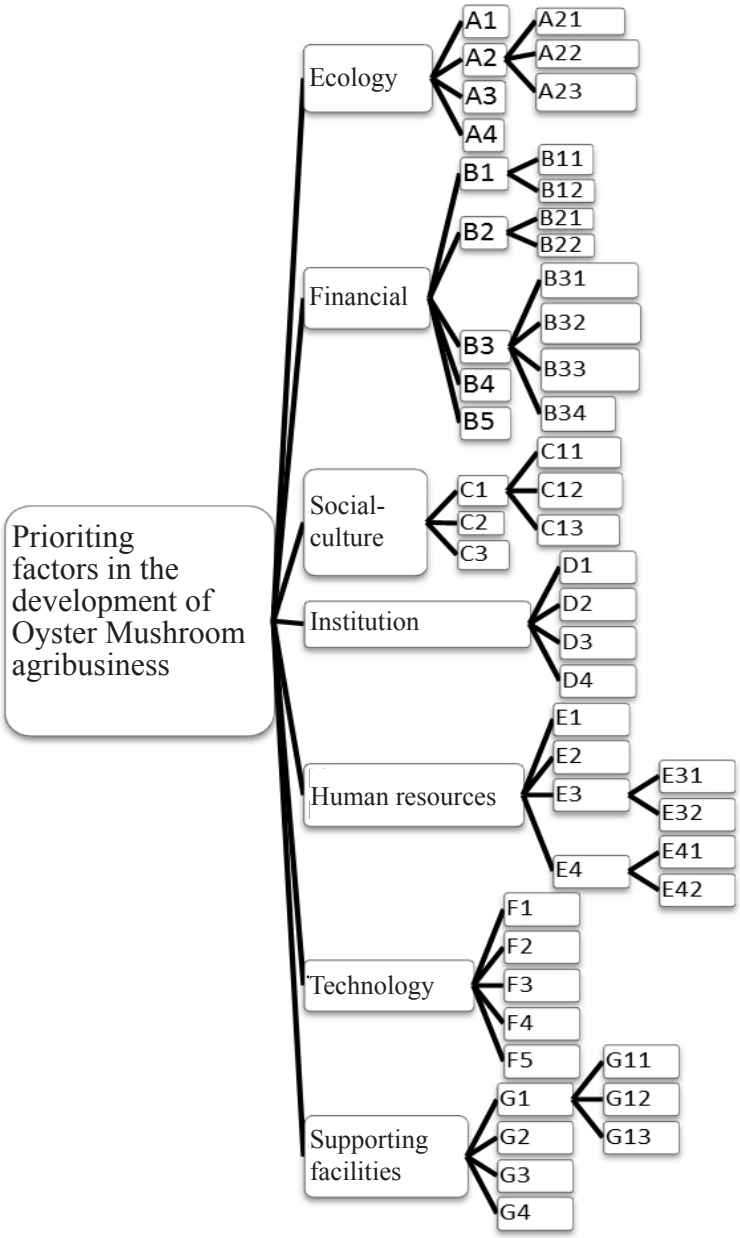
RESULT

Criteria Weights Determination in the Development of Oyster Mushroom Agribusiness in Kubu Raya Regency

The results of the criteria weighting show the most important criteria sequence to be considered in the development of sustainable oyster mushroom agribusiness in Kubu Raya Regency are the supporting facilities criterion (a weight of 0.396), financial criterion (a weight of 0.232) and human resources criterion (a weight of 0.148), as shown in Table 1.

The supporting facilities criterion is the main priority to be considered in formulating the development of oyster mushroom agribusiness. The criterion includes marketing, road access, transportation, and communication networks which are important elements in the development of agricultural product businesses (Aji et al. 2014; Imelda et al. 2017). The key factor to optimize marketing activities is to create material, information, and financial flows between networks to produce maximum consumer satisfaction (Indrajit and Djokopranoto, 2003; Munizu, 2015). The quality and quantity of communication and transportation facilities also play an important role in agribusiness development (Copra and Meindl, 2004).

The second priority is the financial criterion which always becomes a consideration for decision makers in business (Saad et al. 2016; Azizi et al. 2015). This criterion includes the investment value, operating costs, return on investment, productivity, and mushrooms selling price. The third priority is the human resources criterion covering aspects of skills, education, and availability of human resources. Human resources criterion, as the key to the company success, greatly influences the organizational development (Amini et al. 2016; Chiang and Birtch, 2010).



Description:

A1	: OPEFB Potential	B34	: Payback Period	E32	: Informal
A2	: Climatic Conditions	B4	: Productivity	E4	: Labors source
A21	: Temperature	B5	: Mushrooms selling price	E41	: From family
A22	: Humidity	C1	: Perception	E42	: Outside the family
A23	: Rainfall	C11	: Ease of implementation	F1	: Post-harvest technology
A3	: Potential pest attack	C12	: Suitability with needs	F2	: Adoption readiness
A4	: Water source	C13	: Observability	F3	: Technology compatibility
B1	: Investment value	C2	: Mutual cooperation culture	F4	: Cultivation technology
B11	: The price of supporting tools	C3	: Local wisdom	F5	: Harvest technology
B12	: The price of supporting tools	D1	: Capital	G1	: Market
B2	: Operating costs	D2	: Instruction	G11	: Market demand
B21	: Production input costs	D3	: Farmer group	G12	: Market distribution
B22	: Labor costs	D4	: Farmer tools	G13	: Market information
B3	: Return on investment	E1	: Labors skills	G2	: Road access
B31	: NPV	E2	: Labors availability	G3	: Means of transportation
B32	: Net B/C	E3	: Education	G4	: Means of communication
B33	: IRR	E31	: Formal		

Figure 1. Hierarchy model

Table 1. Pair-wise comparison matrix: Main Criteria

	Ecology	Financial	Socio-culture	Institution	Human Resources	Technology	Supporting facilities	Priority Vectors (PV)
Ecology	1	1/3	2	2	1/3	1/3	1/7	0.056
Financial	3	1	7	6	3	3	1/3	0.232
Socio-culture	½	1/7	1	1/3	¼	1/4	1/8	0.029
Institution	½	1/6	3	1	¼	1/3	1/7	0.043
Human Resources	3	1/3	4	4	1	3	1/3	0.148
Technology	3	1/3	4	3	1/3	1	1/5	0.096
Supporting facilities	7	3	8	7	3	5	1	0.396
Total								CR = 0.05

Sub-Criteria Weights Determination in the Development of Oyster Mushroom Agribusiness in Kubu Raya Regency

Ecology Aspect

In terms of the ecology aspect, the most important sub-criteria to consider are the OPEFB potential (a weight of 0.523), climatic conditions (a weight of 0.126), potential pest attack (a weight of 0.089) and water source (a weight of 0.261). The CR value of the ecology factors is 0.05 (CR<0.1). OPEFB potential becomes the most important consideration because of its abundant availability (Olisa and Kotingo, 2014). OPEFB utilization has not been handled optimally by most palm oil companies (Palamae et al. 2017), causing them to have a negative impact on the surrounding environment (Hendra et al. 2014). The use of OPEFB as the mushroom growing media has not been widely performed (Tabi et al. 2008; Hidayati et al. 2015; Kavitha et al. 2013). In West Kalimantan, 61 CPO factories produce OPEFB of 46,237.5 tons per hour (Kusrini et al. 2017). Thus, there is an OPEFB potential that can be used as the oyster mushroom growing media and as an effort to overcome environmental pollution.

Financial Aspect

In terms of the financial aspect, the most important sub-criteria to be considered returns on investment (0.457), mushroom selling price (0.273), and investment value (0.151), operating costs (0.078) and productivity (0.041). The CR value of the economic factors is 0.06 (CR<0.1). Oyster mushroom cultivation business using OPEFB requires a lot of capital for the manufacture of mushroom houses. Return on investment needs to be calculated as a consideration in making decisions to accept/reject a business plan or to stop/retain business which has been or is being implemented (Nurmalina et al. 2009; Kashmir and Jakfar, 2008).

Socio-culture aspect

In terms of the socio-culture aspect, the most important sub-criteria are the perception and attitudes of the community in consuming oyster mushrooms (0.648), mutual cooperation culture (0.230), and local wisdom (0.122). The CR value of socio-cultural factors is 0.00352 (CR<0.1). Beliefs, values, attitudes, opinions, and people's lifestyles at the research location influence the demand for oyster mushrooms. People habit in snacks consumption will increase the production, market share, and customers.

Institution aspect

In terms of the institution aspects, the most important sub-criteria are capital institution (0.543), Alsintan (Agricultural Tools and Machines) institution (0.230), farmer group institution (0.136), and instruction institution (0.070). The CR value of the institutional factors is 0.06 (CR<0.1). To develop oyster mushroom agribusiness, adequate institutional support is needed, especially from the capital institution (Santosa and Marimin, 2001). The capital condition of mushroom entrepreneurs is still not sufficient and there is no assistance from the local government or related agencies. Most of the entrepreneurs' capital comes

from their own capital, bank loans, and non-banking institutions. Therefore, there is a need for additional capital to increase the production capacity of white oyster mushrooms given the unmet market demand. Mushroom entrepreneurs also need technical assistance such as equipment, production factor, training, and incentive provision which aim to enhance the motivation of mushroom entrepreneurs in increasing production capacity.

Human Resources Aspect

In terms of the human resources aspect, the most important sub-criteria are the labors availability (0.538), labors skills (0.274), labors education (0.128) and labors sources (0.060). The CR value of the HR factors is 0.06 (CR<0.1). The labors needed for processing oyster mushrooms require skills and expertise than a high educational level, while the availability of trained labors is difficult to find. The skills and expertise of the labors are very influential on the quality and quantity of products (Fatria, 2017). The quality of the human resources can be improved by increasing the managerial ability and motivation to develop the businesses (Akhmadi et al. 2016).

Technology Aspect

In terms of the technology aspect, the most important sub-criteria are readiness for technology adoption (0.434), technology suitability (0.280), cultivation technology (0.155), harvest technology (0.084) and post-harvest technology (0.047). The CR value of the technology factor is 0.04 (CR <0.1). Technology is one of the main means to achieve effective, efficient, and high productivity efforts (Fatria, 2017). Technological factors consideration is also in accordance with Masyahoro (2006) and Imelda (2018) opinion that technological readiness and quality factors greatly influence the development of the agricultural sector. Technology adoption readiness in utilizing OPEFB as the mushroom growing media such as ease of process, ease of obtaining raw materials and process continuity needs to be fulfilled properly. Mushroom cultivation technology widely used by farmers and mushroom entrepreneurs is in the traditional way and only relies on the experience of mushroom entrepreneurs. This is due to the lack of readiness of business actors in adopting the technology. The lack of technology support can be seen from the limited research results related to mushroom production technology. Supporting Facilities Aspect. In terms of the supporting facilities aspect, the most important sub-criteria are the market (0.541), road access (0.264), means of transportation (0.132), and means of communication (0.064). The CR value of the supporting facilities factors is 0.05 (CR<0.1). This is in line with the researches of Jumna (2015), Santoso and Marimin (2001) and Oelviani (2013) which state that market criterion is the most important criterion in agricultural development. Mushrooms as foodstuffs are important enough for the public food needs, making the production should be increased for the national needs (Sugiarti, 2003). This is the reason why horticultural agriculture requires serious attention regarding aspects of production and marketing system development (Dimyati and Astarina, 2016). Based on this, it is very appropriate to put the market aspect as the highest aspect, considering that mushroom agribusiness production performance is closely related to market problems (Oelviani, 2013; Khoirunnisa et al. 2013).

Synthesis Results

Table 2 shows the conclusions of the priorities of all sub-criteria and sub- sub criteria related to the development of oyster mushroom agribusiness. The overall model inconsistency is 0.05. The weight value of all 23 sub-criteria ranges from 0.003 to 0.541. Market (0.541) is the most important sub-criteria to be considered in formulating the priority factor in the development of sustainable oyster mushroom agribusiness, followed by return on investment (0.457) and investment value (0.151). The weight value of all 20 sub criteria ranges from 0.001 to 0.543. Market demand (0.543) is the most important aspect to be considered in the development of oyster mushroom agribusiness, followed by labor availability (0.093) and Net Present Value/NPV (0.067). Based on the synthesis results, it can be said that the market, which is included in the supporting facilities criterion, becomes a priority factor. It is proven by the current total production capacity of 60 kg per day has not been able to meet the demand for white oyster mushrooms. It provides opportunities for mushroom entrepreneurs to enhance their sales by increasing production capacity to be able to meet existing demand.

Table 2. Local and global weighting of criteria and sub-criteria

Main Criteria	Weight	Sub Criteria/sub-sub criteria	Local weight	Global Weight
Ecology	0.056	OPEFB potential	0.523	0.035 *
		Climate Conditions	0.126	0.126 *
		a. Temperature	0.637	0.008 **
		b. Humidity	0.105	0.003 **
		c. Rainfall	0.089	0.001 **
		Potential pest attack	0.089	0.006 *
		Water sources	0.261	0.018 *
Financial	0.232	Investment value	0.151	0.151 *
		a. The price of supporting tools	0.167	0.004 **
		b. The price of supporting tools	0.833	0.022 **
		Operating costs	0.078	0.078 *
		a. Production input costs	0.833	0.011 **
		b. Operating costs	0.078	0.002 **
		Return on investment	0.457	0.457 *
		a. Net Present value (NPV)	0.543	0.067 **
		b. Net B / C Ratio	0.457	0.031 **
		c. Internal Rate of Ratio (IRR)	0.136	0.017 **
		d. Payback Period (PP)	0.070	0.009 **
		Productivity	0.041	0.006 **
		Mushrooms Selling Price	0.273	0.040 **
Socio-culture	0.029	Perception	0.648	0.648 *
		a. Ease of implementation	0.701	0.012 **
		b. Suitability with needs	0.193	0.003 **
		c. Observability	0.106	0.002 **
		Mutual cooperation culture	0.230	0.004 *
		Local wisdom	0.122	0.002 *
Institution	0.043	Capital	0.543	0.027 *
		Instruction	0.070	0.003 *
		Farmer group	0.136	0.007 *
		Farmer tools	0.252	0.013 *
Human Resources	0.148	Labors skills	0.274	0.047 *
		Labors availability	0.538	0.093 *
		Education	0.128	0.128
		a. Formal	0.008	0.022 **
		b. Informal	0.200	0.006 **
		Labors source	0.060	0.060 *
		a. From family	0.833	0.010 **
		b. Outside the family	0.060	0.002 **
Technology	0.096	Post-harvest technology	0.047	0.007 *
		Adoption readiness	0.434	0.060 *
		Technology compatibility	0.280	0.039 *
		Cultivation technology	0.155	0.022 *
		Harvest technology	0.084	0.012 *
Supporting facilities	0.396	Market	0.541	0.541 *
		a. Market demand	0.637	0.135 **
		b. Market distribution	0.105	0.022 **
		c. Market information	0258	0.055 **
		Road access	0.264	0.066 *
		Means of transportation	0.132	0.033 *
		Means of communication	0.064	0.016 *

Note: * is the global weight of sub-criteria; ** is the global weight of sub-sub criteria

Sensitivity Analysis

Actual results indicate that the supporting facilities aspect is the most important sub-criteria and market demand is the most important sub criteria in the development of oyster mushroom agribusiness (Figure 2). The sensitivity analysis in Figure 3 shows that the weight value changes of a criterion affect the changes in another criterion. The weight change of socio-cultural criterion (last priority) from actual 0.029 to 0.299 will change this criterion to be the top priority with the ease of implementing mushroom business as the most considered sub criteria in the development of sustainable oyster mushroom agribusiness. Meanwhile, institution criterion becomes the last priority (Figure 3). Changes can be made to another criterion.

Managerial Implications

This research contributes greatly to the palm oil industry and the oyster mushroom industry. The priority decision in the use of OPEFB (ecological aspect), one of the solid wastes produced by palm oil processing plants, as the growing media for oyster mushrooms will have direct implications for the palm oil industry in overcoming environmental pollution problems. It also supports the application of the Zero Emissions concept, i.e. the utilization of generated wastes. The use of OPEFB as the mushroom growing media is still limited. Priority decision to improve the supporting facilities aspect (market) implicates the efforts to boost competitiveness and competitive advantage. Therefore, the most appropriate approach model is sustainability. The sustainability approach model proposed in the hierarchy model is easy to understand and more comprehensive in deciding the priority criteria in sustainable oyster mushroom agribusiness development. The application of the AHP model will make business actors create the calculation of priority weighting using multi-criteria. This research will guide academics in the future to use AHP in providing appropriate factors to help sustainable oyster mushroom agribusiness development. This paper will enable practitioners to comprehend and make the right decisions and conclusions for the oyster mushroom industry and business actors to achieve competitiveness.

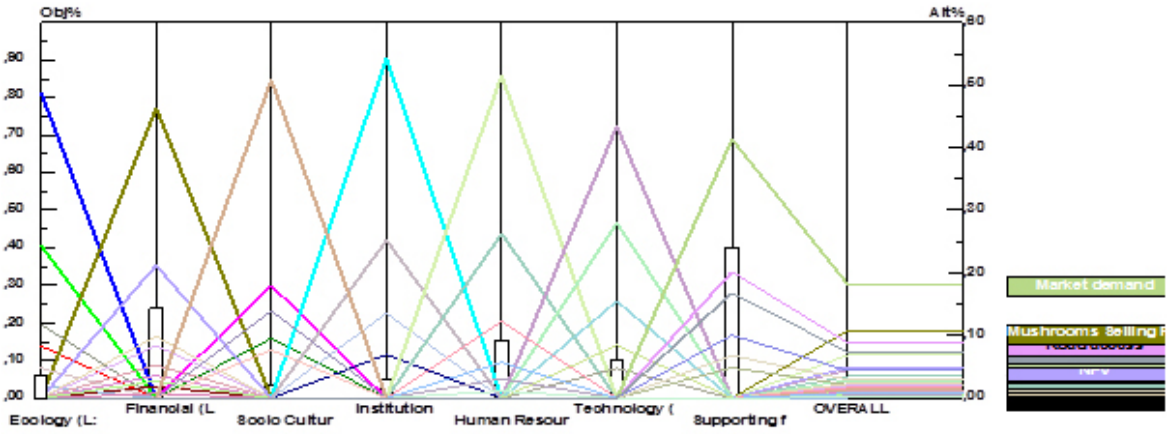


Figure 2. Hierarchy Model

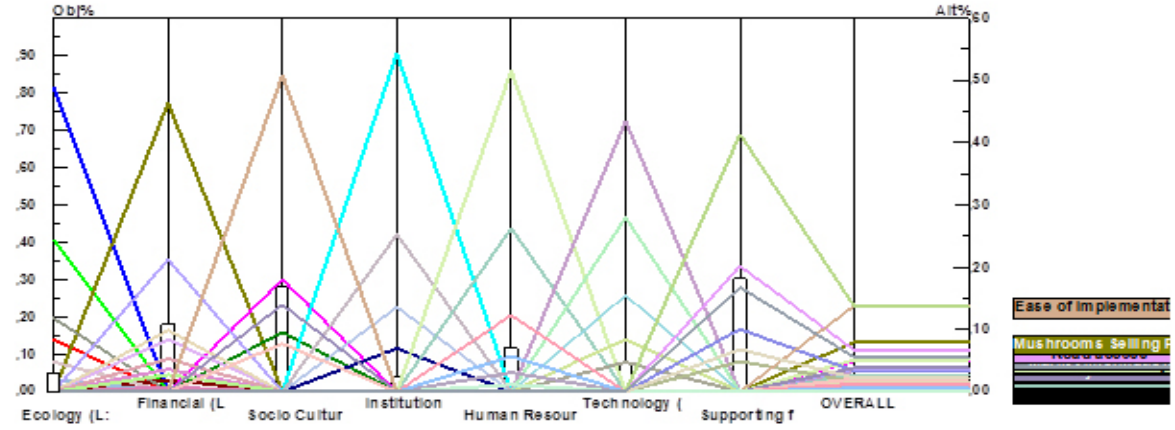


Figure 3. Latest results of sensitivity analysis

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

In this study, the priorities of the main criteria (ecology, financial, social culture, institution, human resources, technology, and supporting facilities) can be determined based on the current business scenario and the experts' judgment in the field. In detail, it can be concluded that the main priority is the supporting facilities aspect in the development of sustainable oyster mushroom agribusiness to achieve competitiveness. The priority of each criterion is OPEFB potential as the mushroom growing medium for ecology criterion, return on investment for financial criterion, perception and attitudes of society for socio-culture criterion, capital for institution criterion, labors availability for human resources criterion, technology adoption readiness for technology criterion, and the market for supporting facilities criterion. The synthesis results conclude that market demand is the most important sub-criteria. The demand management for oyster mushrooms is important so that oyster mushroom agribusiness remains sustainable. Increased production capacity needs to be done to meet the increasing demand for oyster mushrooms. Sensitivity analysis helps in understanding the extent to which priority changes in a criterion affect another criterion. Decision makers assist in determining decisions based on the present situation so that the chosen priority is more flexible and sustainable because it is adapted to the existing changes in the field. Sensitivity analysis helps in understanding the extent to which priority changes to a criterion affect another criterion.

Recommendations

The government's support in the form of technical assistance, training, and incentive provisions for business actors is needed to increase the motivation of business actors. Oyster mushroom production capacity is still low, while market demand continues to increase, making it is necessary to develop oyster mushroom agribusiness. In the future, this research is expected to highlight the different sides of each stakeholder's interests (business actors, governments, palm oil companies) by exploring what can lead to criteria, sub-criteria, and sub-sub criteria in the overall hierarchical model.

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